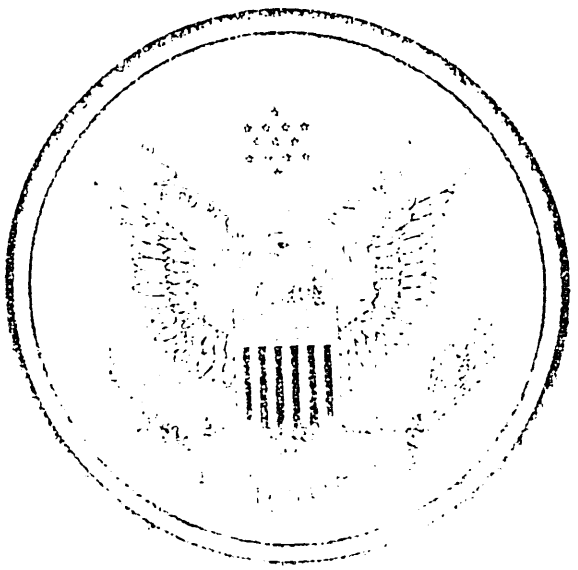
1966

REPORT TO THE CONGRESS

FROM THE PRESIDENT OF THE UNITED STATES



EXECUTIVE OFFICE OF THE PRESIDENT

NATIONAL AERONAUTICS AND SPACE COUNCIL

WASHINGTON, D. C. 20502

DEPARTMENT OF DEFENSE

CHAPTER IV

INTRODUCTION

Three major actions and events highlighted the Department of Defense space and aeronautical activity during 1966. (1) A single TITAN IIIC successfully placed seven communications satellite repeaters and one experimental satellite into equatorial, near-synchronous orbit. This is the initial step toward orbital establishment of the space segment of a defense satellite communications system designed to meet unique and vital communications needs in support of national objectives. (2) A second TITAN IIIC was used to launch eleven DOD experiments and a modified GEMINI spacecraft. The experiments and spacecraft provided test data in support of the MOL program, the communications program, and the Aerospace Research Support Program. (3) Development of the world's largest military cargo aircraft, the C-5A, continued on schedule.

SPACE DEVELOPMENT ACTIVITIES

MANNED ORBITING LABORATORY (MOL)

The MANNED ORBITING LABORATORY (MOL) is being developed to meet the following program objectives:

a. Learn more about what man is able to do in space and how that ability can be used for defense purposes.

b. Develop technology and equipment which will help advance manned and unmanned space flight.

c. Experiment with this technology and equipment.

Management of the MOL Program is being conducted under streamlined organizational structure in which the Director, MOL, reports directly to the Secretary of the Air Force.

The past year has been devoted to the Contract Definition Phase in which sufficient technical data and costing information have been developed to specify in detail the optimum program. Engineering definition has been completed, the baseline configuration has been established, the development and flight schedule has been refined, procurement of developmental hardware has been initiated, and the program is moving progressively toward meeting the established objectives.

Twelve aerospace research pilots have been assigned to the MOL Program. In addition to preparation for their flight duties, they are each assigned special areas on systems engineering and test operations as members of the MOL development team.

In one of the series of TITAN III development flights from the Eastern Test Range, test data useful to MOL was obtained on the TITAN structure integrity and control capability, and on a modified GEMINI spacecraft.

DOD and NASA will continue to coordinate fully their manned space flight efforts. Where feasible the Air Force will accommodate, on a minimum interference basis, such NASA experiments of a general scientific and technological interest as may be economically and effectively conducted.

TITAN III Program

The TITAN IIIC flight test program involved three flights in 1966. The mission of the first of these was to place seven Defense Communication Satellites and one Gravity Gradient Experiment in a near-synchronous orbit of 18,200 nautical miles. It was one of the most complex earth orbital flights ever attempted. The eight satellites were placed in the exact orbit desired and are operating satisfactorily.

The second flight plan was identical to the first. In this case the payload consisted of eight Defense Communication Satellites. After some 79 seconds of flawless performance in flight, the payload fairing suddenly failed, leading to subsequent self destruction of the vehicle. Although the exact reasons for this lack of success could not be absolutely determined, it is believed that the payload fairing experienced structural failure. As a result, a metal fairing in lieu of the original fiberglass honeycomb fairing will be used for the next Defense Communication Satellite mission and all subsequent TITAN IIIC flights.

One objective of the third flight of the year was the test of a modified GEMINI heat shield. In addition, a series of scientific experiments was carried. The test was successful in every respect. The definition phase of the modified TITAN III, known as the TITAN IIIM, was completed and long lead time procurement was initiated for the development phase. This configuration of the TITAN III will be used to boost the MANNED ORBITING LABORATORY (MOL).

Also during this year the TITAN IIIB development program was completed on schedule in July 1966 by the successful R&D launch of the first vehicle from Vandenberg AFB. The TITAN IIIB vehicle, which consists of the first two liquid stages of the basic TITAN III plus an AGENA upper stage, was developed to meet polar orbit mission requirements.

DOD Satellite Communications Activities

To provide the prompt, reliable, secure, and flexible communications vital to the United States in support of its global responsibilities, to command its forces, and to control its weapons, the DOD has continued its efforts to exploit the demonstrated ability of orbiting satellite radiowave repeaters together with appropriately designed surface terminals to provide such communications.

Defense Communications Satellite Program (DCSP)

The objectives of the Defense Communications Satellite Program are to conduct necessary satellite communications research and development, and to establish an operational long haul point-to-point satellite communications system in a timely

manner. The DCSP is carried out by the three Military Departments with the Defense Communications Agency providing management and operational direction to coordinate the Departmental efforts.

To accomplish these objectives, the DCSP is divided into three broad efforts as follows:

a. SYNCOM

b. Initial Defense Communications Satellite Project (IDCSP)

c. The Operational Defense Satellite Communications System (DSCS)

SYNCOM

SYNCOM II and SYNCOM III, developed and orbited by the National Aeronautics and Space Administration, were used with various DOD terminals in 1966 for experimental system test activities and for passing operational communications. The SYNCOM system was converted to operational status in July 1966 and is currently being employed as an alternate to cable and high frequency radio circuits between land terminals in Hawaii, Philippines, and Southeast Asia; a shipboard terminal installed on the USS ANNAPOLIS is also being used in this system. The SYNCOM system will be used for the remaining life of the satellites -- currently estimated to be about two years for SYNCOM II and five years for SYNCOM III.

Initial Defense Communications Satellite Project (IDCSP)

This project is designed both to provide an in-being research and development satellite communications system to demonstrate system feasibility on a world-wide network basis and to provide an early, though limited, operational capability to supplement the essential command and control communications system of the DOD.

The first spacecraft-repeaters were successfully launched in June 1966. A single development model TITAN IIIC performed in near-perfect fashion to inject seven satellites and one gravity gradient stabilized test satellite into circular, equatorial orbit at a near-synchronous altitude of approximately 18,000 nautical miles. The satellites were sequentially injected into orbit and each was given a small increase in velocity with respect to the preceding satellite to cause a "random" dispersion of the satellites around the orbit. A second launch attempted in August 1966 failed and the DOD is examining possible reasons for the failure, including the protective fairing surrounding the satellites.

The IDCSP surface subsystem consists of newly developed ground and shipboard terminals. During 1966 ground terminals were established for world-wide communication -- on the east and west coasts of the United States, and in Germany, Hawaii, and the Philippines. The first shipboard terminal was tested aboard the USS PROVIDENCE, flagship of the First Fleet, in October 1966. As the year came to an end, terminals were being installed and checked out in Southeast Asia to support operations in that area. Development of a smaller, lighter ground terminal, transportable in a single aircraft, continued throughout 1966 with system testing beginning in November 1966.

The Operational Defense Satellite Communications System (DSCS)

During 1966 the DOD continued planning and preparation for acquiring a truly operational satellite communications system which will take full advantage of our experience with the SYNCOM and IDCSP circuits and of advances in communications, spacecraft and rocket technology. System definition studies were completed and implementing direction was prepared.

Tactical Satellite Communications (TacSatCom) Program

Operational advances in such areas as strategic and tactical weaponry, transportation, and combat surveillance -- both in our forces and those of potential enemies -- place a related demand on improving our means for commanding the operating forces, providing them promptly with adequate intelligence and controlling their weapon systems. Often, tactical combat forces are restrained from exploiting the full potential of their fire power and maneuver capabilities because of limitations on the means provided for command, control and communications. Recent Military Department studies have confirmed that important tactical communications requirements could be met by sensibly designed satellite communication equipments and networks. Also, rapid national progress in the development of economical space boosters and sophisticated spacecraft in recent years suggest that properly designed orbiting repeaters, used in concert with appropriate surface and near surface equipments, could go far toward meeting military tactical communication needs.

The program is directed toward meeting the needs of the highly mobile, lower echelon land, sea and air forces using very small, lightweight and relatively less costly tactical equipment in networks characterized by great flexibility and minimum control. During 1966, the Military Departments formed a Tri-Service Executive Steering Group (TSEG) to manage a joint research and development program with the following objectives: (a) to develop and test experimental space and surface satellite communications hardware, (b) to develop operational concepts for the confident military use in large scale communication networks, and (c) to demonstrate and test those concepts in an operational environment.

The Army has the primary responsibility for the development of the experimental ground equipments; the Navy, the seaborne terminals; and the Air Force, the airborne terminals. The Air Force also has the responsibility for developing and launching the spacecraft/repeaters which the Services agree will meet their needs. Joint development projects ensure that only a minimum number of surface equipment types will be developed. A joint test program will be devised and implemented.

Initial experiments are keyed to the launch of an Air Force-MIT UHF repeater by a developmental TITAN IIIC booster early in 1967. During 1966, the Military Departments developed, fabricated and installed suitable terminals in combat vehicles, ships and aircraft in line with the joint test program to be implemented during 1967. Contractual action was also initiated in 1966 for a second satellite, one specifically designed to meet the goals of this program, for launch in 1968 using a developmental TITAN IIIC booster. By then, suitably designed surface terminals will be installed in a sufficient number of tactical vehicles, operational aircraft and Navy combat surface ships and submarines to permit adequate technical and operational testing in simulated and real tactical environments. The development of an actual operational tactical satellite communication system will depend on the results of the 1967-1968 experimental program.

Experimental Communications Satellites

Two experimental satellites, designed and built by the MIT-Lincoln Laboratory under DOD sponsorship, were placed in orbit in December 1965 by a TITAN IIIC. These satellites, LES-3 and LES-4, were placed into a elliptical orbit rather than the planned circular, near-synchronous orbit; however, planned experiments were successfully conducted during 1966. LES-3 included a UHF transmitter and was used to make accurate measurements of UHF propagation phenomena. LES-4 operating at SHF, demonstrated the feasibility of using sensors to select, from a number of antennas, the one antenna pointing most directly toward earth so that the energy radiated by the satellites is directed to the earth. LES-4 also yielded valuable data on electron density throughout the orbital path. The Laboratory continued the design and fabrication of LES-5, a larger UHF satellite to be launched in 1967.

International Satellite Communications Discussions

During 1966 the DOD held a number of discussions with friendly nations to acquaint them with the DCSP; initial reaction indicates considerable interest in the potential of satellite communications for military purposes. A Memorandum of Understanding was concluded with the United Kingdom for their participation in the research and development phase of the IDCSP. Arrangements were also made for Canadian participation in IDCSP research and development.

The United States Ambassador to the North Atlantic Treaty Organization proposed a cooperative program to provide the NATO an early operational satellite communication capability.

Spaceborne Nuclear Detection (VELA)

Development of a satellite based nuclear detection capability for events occurring on the earth's surface to the outer reaches of deep space has been the design of the VELA Satellite Program. Originally a research and development program of the Advanced Research Projects Agency, it is conducted jointly by the USAF and AEC.

There are six VELA satellites presently in orbit. The satellites were launched in pairs in 1963, 1964 and 1965. All six are still providing valuable data on the radiation environment in space and on the operation of nuclear detection sensors in space. The VELA program is providing an interim monitoring capability for detecting nuclear explosions occurring in the region from the earth's surface to deep space. Future launches are planned to maintain the present system, in addition to continued research on advanced space detection techniques.

VELA satellites are launched from Cape Kennedy into near-circular orbits about 60,000 nautical miles from earth. The radiation background data has and is making valuable contributions in techniques of solar storm forecasting. The VELA program also provided a real-time radiation cover to the GEMINI manned space flights.

VELA satellites will continue to provide this important radiation detection service for future manned spacecraft flights.

Space Object Identification

The Air Force and Advanced Research Projects Agency are cooperating on a continuing research program to determine the best means by which the physical characteristics of uncooperating objects in earth orbit can be obtained through observations by ground-based radar. The advanced techniques will be of value in obtaining diagnostic information on our own satellites in orbit and will serve as a prime source of technology for improving the capabilities of the Space Surveillance and Detection Tracking System (SPADATS). Plans are being made for transfer of the ARPA research efforts in this area to Air Force management.

Geodetic Satellite

The Department of Defense continued its active participation in the National Geodetic Satellite Program during 1966. The NASA's EXPLORER XXIX satellite (GEOS A), launched November 6, 1965, is being observed on a world-wide basis by DOD as well as other participating Government agencies. EXPLORER XXIX carries an Army SECOR transponder, a NASA Range-Range Rate transponder and LASER reflector, an Air Force optical beacon, and a Navy Doppler beacon.

The NASA's PAGEOS A satellite launched in a 2000 nautical mile orbit in June 1966 is currently being observed by DOD and the Coast and Geodetic Survey for establishing a world-wide Geometric net of 43 stations. PAGEOS is a reflective 100' inflatable sphere observed simultaneously against a star background from at least two ground stations.

These projects will continue to provide more precise information about the earth's size, shape, mass and variations in gravity and precise determinations of locations for accurate mapping, charting, and geodesy.

The Army Corps of Engineers has extended a continuous geodetic network from Japan to Hawaii using the SECOR (Sequential Collation of Range) satellite system. Three SECOR satellites, VI, VII, and VIII, with a newly developed high altitude performance capability, were successfully orbited in 1966. Of the three, the SECOR transponder in VII is functioning favorably, and it is anticipated greater distances between stations will soon be possible. Operations will begin in the near future on a 30-station globe-circling network designed to link all major geodetic datums, provide a new determination of the earth's equatorial radius, and provide scale to the PAGEOS satellite triangulation network.

During 1966, the Navy determined from Doppler observations, the positions of 21 world-wide stations to an accuracy of $\pm$ 25 meters with respect to the earth's center of mass. Additionally, the Doppler data was used to determine the harmonic coefficients of the earth's gravitational potential. Coefficients through the eighth order have been published. The Doppler beacons in the Navy Navigation Satellites, NASA's Beacon B, Beacon C and GEOS A are being used for gathering the Doppler data.

In 1966, the Air Force completed two programs using the PC-1000 geodetic stellar cameras. Trinidad has been related geodetically to Cape Kennedy for the Eastern Test Range with an accuracy of 10 meters (1σ). In the U.S., the PC-1000 cameras were used to provide comparative data with the SECOR and Doppler systems. The

three systems, in turn, were checked against the Coast and Geodetic Survey's super accurate base line. Favorable results were obtained. Currently, the Air Force is engaged in establishing eighteen stations world-wide for defining the GEOS orbits more precisely and to assist in verifying major datums of the world.

Navy Navigation Satellite System

The Navy Navigation Satellite System has been in operation since 1964. Receivers are installed in all Fleet Ballistic Missile submarines and all attack carriers deployed to Southeast Asia to up-date the ships' inertial navigators and to insert data into the inertial navigators of aircraft prior to launch from the carriers.

During 1966 the use of the Navigation Satellite System for up-dating an aircraft's inertial system was found feasible. Flight tests were performed using shipboard equipments with an existing inertial navigator and an interconnection system that was considerably less than optimum. Now that the feasibility of the technique has been shown, a receiver designed specifically for the aircraft application will be developed and tested to determine the potentials of its operational use in military aircraft.

Also during 1966 the accuracy of the system was improved by the use of more detailed and accurate knowledge of the earth's gravity field with a consequent improvement in predictability of a satellite's position. The system is also now being used by oceanographic and range instrumentation ships as a primary source of accurate, all-weather position data.

To give artillery units the capabilities of locating themselves accurately in relation to one another, a 50 lb. navigation satellite receiver suitable for carrying as a back-pack was developed. Accuracies equivalent to those obtained by surveying can be obtained by one satellite pass without the necessity for laborious, time-consuming and sometimes dangerous conventional 4th order survey techniques. Further development work will be done to make this receiver suitable to actual field conditions. Both the Marine Corps and Army plan to exploit the technique if it proves operationally feasible.

Meteorological Systems

The first NASA TIROS Operational System satellite with a direct readout capability was launched in 1966. Concurrently Navy attack carriers deploying to Southeast Asia were provided with equipment for utilizing this technique. Thereby, for the first time the task force commander or captain of a ship was able to determine in real time the actual cloud conditions in the Task Force area of operations with a single overhead pass of the satellite.

SPACE GROUND SUPPORT

DOD National Ranges

The realignment of the National Range complex continues as program support requires change. On the Eastern Test Range, the San Salvador Station was deactivated and both Advanced Range Instrumentation Ships were moved to the Pacific Ocean. On the Western Test Range, Vandenberg Air Force Base was expanded with the acquisition of Sudden Ranch. Several older launch complexes at Vandenberg AFB are being modified

to accommodate the newer versions of THOR and TITAN space boosters.

Instrumentation improvements on the Department of Defense Ranges were limited by available funding. The major modifications now underway are directed at improving radar accuracies and converting the telemetry systems from the Very High Frequency (VHF) spectrum to the Ultra High Frequency (UHF) band. This latter is a directed action to relieve some of the congestion in the 200 to 400 megacycle spectrum. Instrumentation improvements for re-entry and terminal measurements have been initiated and must continue next year to meet the needs of ballistic missile systems which will be flying on the Eastern and Western Test Ranges.

The instrumentation system for the first APOLLO ship (the VANGUARD) has been completed and this ship is now undergoing engineering tests. The second of these five range ships (the REDSTONE) is nearing completion and will be delivered about February 1967 for testing and operational shake-down. The first two of eight APOLLO range instrumentation aircraft were delivered in November 1966.

Conversion of the Satellite Control Facility to the Ultra High Frequency spectrum passed a significant milestone on 13 October 1966 with the successful flight test of the Space Ground Link Subsystem. Two tracking stations were equipped with prototype hardware to support this and subsequent flight tests. Production is now underway to equip the entire network with this system which permits transmission of more than a million bits of data per second between space vehicles and ground terminals. A new UHF antenna is now being installed at the Hawaiian Tracking Station and work has been initiated to install a similar high gain antenna at the Guam Tracking Station.

TITAN III Facilities at WTR - MOL Launch Complex

Site preparation for the TITAN III launch facility at WTR was completed in August 1966. This work included land grading and installation of access roads and utilities. The next phase of facility construction, including items specifically associated with MOL, has been approved, and construction will commence in the early part of 1967.

Space Detection and Tracking System (SPADATS)

SPADATS operation is under the control of the North American Air Defense Command (NORAD). It consists of detection and tracking radar systems assigned to the Air Force (SPACETRACK) and the Navy (SPASUR). SPADATS is responsible for the detection and tracking of all foreign and friendly earth orbiting objects. Support of Service and NASA space programs such as GEMINI, APOLLO and the MANNED ORBITAL LABORATORY (MOL) is also a function of SPADATS. The SPADATS capabilities are constantly being evaluated for possible improvements in operation and for required equipment modifications and additions. Advances have been made in the capability to provide more precise predictions of satellite orbital positions and determine space object decay times and locations. Such improvements are enabling the U.S. to advance our knowledge of the earth's atmosphere, shape and of various extra terrestrial effects upon orbital flights.

The study contracts let this year fall into three general groupings. First, there are four radar contractors making preliminary design studies of radars that will have the ability to detect and track aircraft against a background of ground returns. Second, two contractor teams are examining the command, control and communications problems entailed in providing communications, data processing and displays. Significantly, these studies are defining what must be done to make AWACS compatible with the other services and our allies. Finally, two aircraft system contractors are reviewing the above mentioned studies and other factors which affect the proposed aircraft. The result of the system studies will be a cost-effectiveness trade-off analysis which will be used to validate the concept formulation and to support the contract definition phase.

COOPERATION WITH OTHER GOVERNMENT AGENCIES

Coordination and cooperation with other governmental activities, particularly NASA, continues at a high level. These include very frequent informal discussions at all levels of the respective agencies, scheduled meetings of formal coordinating panels and boards, and direct support o NASA.

Aeronautics-Astronautics Coordinating Board

The Board held five meetings during CY 1966. Examples of its activities are: reusable launch vehicle studies, coordination of planning of new facilities, examination of advanced large liquid fuel engine, and use of navigation satellites.

Manned Space Flight Policy Committee

DOD and NASA, by agreement of January 1966, established a "Manned Space Flight Policy Committee" as a means of expediting coordination at a policy level the manned space flight programs of the two agencies. Three meetings of the Committee were held during 1966.

DOD Participation in the GEMINI Program

This program, consisting of fifteen separate experiments, has been directed towards enhancing the DOD manned space flight experience level by conducting and evaluating techniques and equipment on the NASA GEMINI missions.

During 1966, eleven DOD experiments were flown on four GEMINI missions. The early termination of the GEMINI 8 mission and Extra Vehicular Activity (EVA) curtailment due to some astronaut and operational difficulties on GEMINI missions 9, 10 and 11 precluded totally successful completion of all DOD experiments. However, rescheduling some of the early experiments that were not conducted to later missions permitted a substantial accomplishment of experiment objectives.

With the successful completion of the D-15 Night Image Intensification Experiment on GEMINI XI, the Navy concluded its series of experiments in the GEMINI program. The Navy's experiments included D-15, D-14 UHF/VHF Polarization Measurement and D-15 Astronaut Visibility; all experiments were successfully accomplished.

DEPARTMENT OF STATE

CHAPTER VI

INTRODUCTION

The President's decision to seek increased cooperation with other technically advanced nations in advanced space exploration projects was greeted in Europe with great interest. United States embassies in Europe carefully briefed their host governments on the President's offer of cooperation. In February a NASA/Department of State team visited the major European capitals and space science centers to discuss the offer in detail. Senior officials also made a visit to Europe in September for additional discussions. This initiative toward increased cooperation in space exploration has stimulated interest in bilateral and multilateral cooperative projects and in the role of space programs in solving the problems of the technological gap.

A review of policy on the export of space technology has enabled the Department to inform European governments of U.S. willingness to increase its assistance to multinational development of a space launch capability.

The United Nations took several important decisions relating to outer space. The most significant was the agreement reached on the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies." The President has called this treaty "the most important arms control development since the limited test ban treaty of 1963." The treaty forbids the placing of weapons of mass destruction in outer space or on celestial bodies, restricts military activities on celestial bodies, bars claims of sovereignty and national appropriation, and contributes in a number of other ways to the establishment of a legal regime in outer space.

The General Assembly also approved recommendations of the Outer Space Committee for a United Nations conference on outer space to be held in Vienna in September 1967. The conference will focus on two basic subjects: practical benefits of space programs, with special reference to the needs of developing countries, and opportunities available for international cooperation in space programs. The U.N. Assembly also endorsed recommendations resulting from the work of the Scientific and Technical Subcommittee including one to establish a working group to consider the development of an international navigation-services satellite system.

The Department was pleased to forward through its science attaches and scientific affairs officers at missions overseas SURVEYOR I and LUNAR ORBITER I photographs for appraisal by foreign scientists. Our ambassadors were also provided with selected copies for presentation purposes.

The Department stimulated interest of foreign governments in the Automatic Picture Transmission (APT) system for receiving cloud-cover photographs from U.S.

weather satellites by having U.S. missions present information on the benefits and low cost of the system. The appreciation shown for the APT system has been encouraging. A number of countries have made up for their lack of funds to purchase commercial equipment by the ingenuity shown in building APT receiving sets from locally available materials.

The Department has continued to support the national space program by negotiating station agreements, assisting in contingency arrangements for astronaut recovery, and obtaining foreign cooperation and support for various aspects of the program. It has also taken an active part in encouraging broad participation in the development of a commercial global satellite communications system.

ACTIVITIES WITHIN THE UNITED NATIONS

A Working Group of the Committee on the Peaceful Uses of Outer Space met in New York January 18-25, and again September 6-9, to consider a proposal for a United Nations conference on Outer Space. It recommended a conference focused on two basic subjects: practical benefits of space programs, with special reference to the needs of developing countries, and opportunities available for international cooperation in space programs. A detailed agenda covering all aspects of these subjects was developed. The Working Group also recommended that the conference, which will not be empowered to make recommendations or decisions, be held in Vienna in September 1967.

The Scientific and Technical Subcommittee of the Outer Space Committee met April 18-27 at the European U.N. Headquarters in Geneva. The Subcommittee agreed on a number of recommendations, of which the most significant were:

a. five guidelines for evaluating requests for international support of training programs in the specialized field of space science.

b. a Space-Committee Working Group to consider the need, feasibility, and implementation of a navigation-services satellite system.

c. means to improve the usefulness and distribution of U.N. publications in the field of outer space.

The Space Committee's Legal Subcommittee met twice in 1966 -- July 12-August 4 and September 12-16 -- and its members conducted nearly continuous informal negotiations. On December 8, they announced agreement on a "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies." Work had begun shortly after May 7, when the President suggested a number of elements for such a treaty and asked the U.S. Ambassador to the United Nations to seek early discussions in the United Nations.

The Treaty forbids the placing of weapons of mass destruction in outer space or on celestial bodies -- thus incorporating the "no-bombs-in-orbit" U.N. resolution of 1963 -- and placed restrictions on military activities on the moon and other celestial bodies. To allow verification, open access to all areas on celestial bodies is guaranteed. The Treaty also contains a number of principles designed to

establish a legal regime in outer space. Among the most important are the following:

a. freedom of exploration and use of outer space and celestial bodies for all States on a basis of equality.

b. activities in outer space and on celestial bodies are subject to international law, including the United Nations Charter.

c. claims of sovereignty and national appropriation are barred.

d. an unconditional obligation exists to help and to return astronauts promptly and safely if they land elsewhere than planned, and to exchange information relating to astronaut safety.

e. activities in outer space and other celestial bodies are to be reported to the Secretary-General of the United Nations to the greatest extent feasible and practicable.

f. provision is made for the avoidance of harmful contamination and for international consultation in connection with potentially harmful space experiments.

g. a launching state shall be internationally liable for damages caused by its space vehicles.

The Outer Space Committee endorsed the recommendations of the Scientific and Technical Subcommittee with little debate and noted the partial report of the Legal Subcommittee. The U. S. Ambassador to the United Nations drew attention to the broad opportunities for international cooperation available in our national space program.

On December 19, the U.N. General Assembly adopted by acclamation a resolution endorsing the draft treaty and asking the Outer Space Committee to begin study of related legal topics. The Assembly also adopted two other resolutions: one endorsed the recommendations of the Scientific and Technical Subcommittee; the other approved the holding of the U.N. space conference in 1967. All three of the Space Committee's major lines of action in 1966 thus culminated in General Assembly endorsement and approval.

TRACKING NETWORKS

NASA Facilities

Government-to-Government agreements by exchange of notes are in existence with the following countries covering the foreign portion of NASA's global tracking network: Australia, Canada, Chile, Ecuador, Malagasy Republic, Mexico, Nigeria, Peru, South Africa, Spain, and the United Kingdom. These facilities consist of stations supporting the manned space flight program, a tracking and telemetry network for scientific satellites, and deep-space antennae at four locations around the world. These are in addition to the U.S. Air Force's Eastern Test Range facilities which are also used by NASA.